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NCEL
Techdata Sheet

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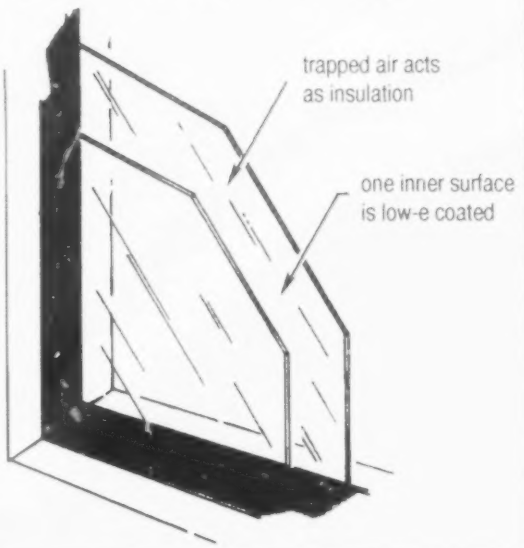
SPECIFY ENERGY EFFICIENT WINDOWS AND SAVE $$

Double-glazed, vinyl-framed low-e windows can reduce heat losses by 80% compared to wood- or metal-framed, single-glazed windows.

To reduce energy loss through windows, we have examined energy efficient windows to determine cost effectiveness. Over the next two years, we will be identifying framing and glazing options, developing simple equations or procedures to determine the best option for each application, and preparing a User Data Package (UDP) for use by field personnel for determining the best options, both for new construction and for replacement of existing windows. The UDP is planned to be issued by about Sept 1990. Enough information, however, has already been gathered to permit some general observations and tentative conclusions to be disseminated.

If you are faced with replacing windows in family housing, consider the advantages of these windows, which need no painting. Cost savings could be as high as $360/year for the average house (120 sq ft of windows). Savings will vary with heating/cooling requirements and the cost of energy.



WINDOW FRAMES AND GLAZING

Window Frame. We have examined wood, vinyl, aluminum, aluminum with a thermal barrier, vinyl-clad wood, aluminum-clad wood, vinyl-clad aluminum, steel, and fiberglass window frames. Wood was found to be unsuitable as a framing material for high efficiency windows

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because it swells, rots, warps, splits during nailing, burns, becomes discolored by moisture, and requires frequent painting. Nontreated wood can be attacked by termites or other insects. A short time after installation, wood windows develop higher infiltration rates than other windows to such an extent that heat losses due to infiltration can easily exceed heat losses due to conduction. Aluminum and steel were rejected because of their high thermal conductivity. Aluminum with a thermal barrier was rejected because of the frequent separation of the thermal barrier, resulting in wide cracks and increased infiltration. Since fiberglass window frames are relatively new, there is insufficient experience to permit judgment on their effectiveness. The vinyl-clad wood, vinyl-clad aluminum, and aluminum-clad wood have the disadvantages of wood, aluminum, or both.

In conclusion, we found rigid vinyl to be the framing material of choice because:

- The R-value (inverse of U-values measured in Btu/hr-sq ft-F) of a vinyl window shows it to be as good as any other window in reducing heat losses.
- Vinyl windows require far less maintenance than wood windows.
- The color is locked in the material, so vinyl windows never need painting.
- The vinyl material won't chip, flake, rust, rot, pit, fade, blister, or peel.
- It cannot be penetrated by termites, other insects, or mold.
- It is abrasion-resistant and chemically inert.
- It will stand up to the onslaught of acid rain, salty seashore air, urban pollutants, and corrosion.
- Sound transmission through vinyl is low.
- Rigid vinyl cannot be ignited, cannot sustain burning by itself, cannot cause a fire to spread, and cannot conduct electricity.
- It lubricates itself to ensure easy sliding.
- Vinyl windows are light weight.
- Some vendors provide custom-fit vinyl replacement windows, which can be installed quickly and easily without the services of carpenters, bricklayers, painters, or plasterers.

Disadvantages of vinyl are few:

- It has low strength; consequently, all recommended vinyl windows must have reinforcing channels or tubes.
- Since the color is locked in the material, vinyl windows should not be painted or stained.
- Some colors absorb a large fraction of the solar incident energy and may not have a long life. Therefore, a color with a lifetime warranty is recommended.

Window Glazing. A single-glazed window has an R-value of about 0.86, whereas the R-value of a double-glazed window is about 2.0. This doubling of thermal resistance increases the price by only about 20%. From preliminary calculations, it is evident that a double-glazed window is preferable over a single-glazed window in most applications.

There are several types of low-emissivity (low-e) coatings that can be applied to one of the inner surfaces of a double-glazed window to further increase its R-value to 2.7. These coatings come in soft-coat as well as hard-coat varieties. Detailed discussion of these varieties is outside the scope of this Techdata Sheet, but a hard coat appears to be a better choice because of its superior handling characteristics. There are many other options available to increase the R-value of double-glazed windows: from evacuated glass, to inert gas between the two glazings, to electrochromic windows, to aerogel between the glazings. *However, for Navy applications, a rigid vinyl, double-glazed window with a hard, low-e coating appears to be the most cost effective.*

COST SAVINGS

Of the approximately 90,000 family housing units in the Navy and MARCORPS, 85% are located in climates that require 4,000 (or more) degree-days of heating and/or cooling. A house with 120 sq ft of conventional single-glazed, wood-framed windows located in such a climate would require 360 gallons of No.2 fuel oil per year for heating in winter (or equivalent energy for air conditioning in summer) *just to make up* for the energy lost through the windows. At an assumed cost of $1.00/gallon, this loss is equivalent to $360/yr.

Also, heat loss due to air infiltration through a double-glazed vinyl window is a small fraction of the heat loss through an existing, single-glazed, wood-framed window.

The combined reductions in conduction and air infiltration losses (when using the recommended window to replace an existing conventional window) can save about 84% in energy losses. In addition, the recommended window requires less maintenance, and it minimizes draft near the window.

Therefore, it pays big dividends to specify thermally efficient windows for new construction as well as for existing housing.

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